PURDUE
UNIVERSITY

MANUFACTURING EXTENSION PARTNERSHIP

MISSION: TO ADVANCE ECONOMIC PROSPERITY, HEALTH AND QUALITY OF LIFE IN INDIANA AND BEYOND.

E3 SUMMARY

ECONOMY
ENERGY
ENVIRONMENT

PURDUE
UNIVERSITY
MANUFACTURING EXTENSION
PARTNERSHIP

Cumulative Assessment Estimated Summary:

- **Key Lean Opportunities: $695,500** Savings
- **Energy Savings Opportunities: $332,000** Savings
- **W.A.S.T.E. Stream Opportunities: $514,300** Savings
- **Greenhouse Gas Emissions Reductions: 18,216 Tons** CO_2-Eq

SUMMARY

ECONOMY ENERGY ENVIRONMENT

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Cumulative Assessment Estimated Impacts:

	Lean VSM Savings	Energy Audit	W.A.S.T.E. Stream Mapping	MTCO2e Reduced	Total $ Savings
Company #1	$87,500	$81,600	$40,300	1,691 tons	$209,400
Company #2	$174,400	$145,800	$239,000	1,620 tons	$559,200
Company #3	$201,600	$6,200	$108,800	82 tons	$316,600
Company #4	$232,000	$98,400	$126,200	626 tons	$456,600
TOTAL	$695,500	$332,000	$514,300	4,019	$1,541,800

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

CASE STUDY #1

Indiana Wood Product Manufacturer

Working 6:30am-4pm 5-6 days/wk

Annual production= 233,000 pieces

No. Employees = 200

Annual Elec. Cost = $293,280

Annual Nat. Gas Cost = $150,726

CASE STUDY #1

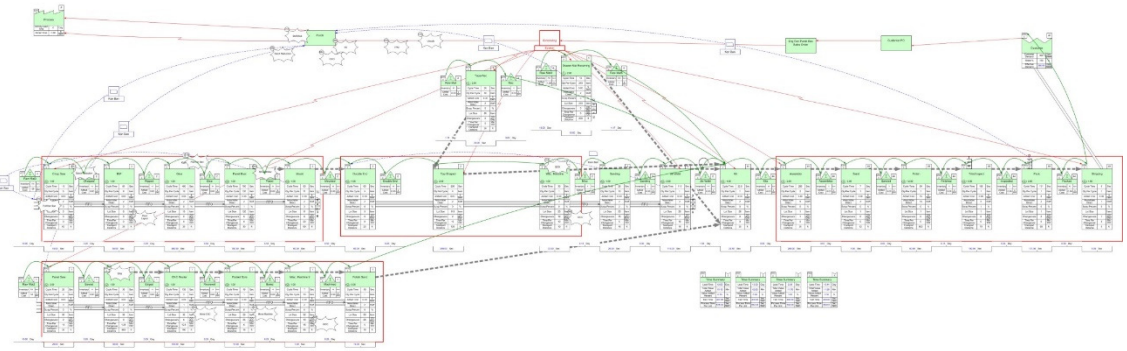
PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities



- Install FIFO Lanes
- Set up Supermarkets
- Rearrange into cells
- Set up QCO
- Develop Visuals & Standardize work

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Actual Lean Opportunities

$309,500+
annual savings

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Estimated Lean Opportunities = $87,900 cost savings

- ✓ **$120,000 total invested in equipment**
- ✓ Lead time has been reduced from 10 weeks **to just 6 weeks**
- ✓ Identified delays due to slow changeover at the molder have been reduced by **outsourcing** and using molder only for what it is most efficient at doing. This saves at least 1 hour per day, plus reduced cost from specialized supplier, totaling a cost savings of $50,000 annually.
- ✓ Invested $60k in new Double Ender equipment, **reducing changeover from 45 minutes down to 5 minutes**. Cost savings of $60,000 annually.
- ✓ Working on rearranging layout into cells. Increased **efficiency of the layout** requires fewer workers, which has allowed workforce to be dedicated elsewhere. Cost savings = $87,000 annually.

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Estimated Lean Opportunities = $87,900 cost savings

- ✓ Invested $30k in a new Pocket Borer machine that also inserts the screws, creating **labor savings of 50%**. This also results in another reduced step in assembly, freeing up another 0.5 FTE. Combined cost savings = $50,000 annually.
- ✓ New visual aids have been installed plant wide. Increased clarity and effective **communication have reduced rework 50%.** Cost savings = $50,000 annually.
- ✓ New feed machines were installed in the sanding area, resulting in labor savings of $12,500 annually.
- ✓ Overall, changes allowed the company to completely shut down one finish line and keep productivity the same.

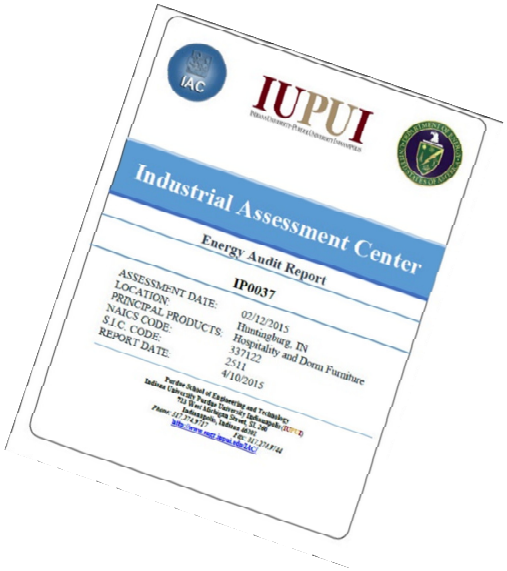
CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

- Lighting
- Compressed Air
- HVAC
- Heat Recovery
- **Switching from wood burning boiler**
- Other – manufacturing tax incentive



CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary: Actual Energy Savings

- ✓ **Actual utility cost savings = $59,000+**
- ✓ **Total Electricity reductions = 90,935 kWh (GHG reductions = 86 MTCO2e)**
- ✓ **Total Natural Gas reductions = 2,840 MMBTU (GH reductions = 151 MTCO2e)**
- ✓ Wood burning boiler was decommissioned & natural gas unit heaters were installed throughout the building to create a more consistent, comfortable temperature.
  - ✓ One time cost savings of $35,000 by not repairing the old boiler and water treatment.
  - ✓ Eliminated requirement for Night Watchman. Labor savings = $25,000.
  - ✓ Eliminated 1,000 tons of wood waste being burned. Now sold to farmers.
  - ✓ **Eliminated 1,438 MTCO2e**

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary: Actual Energy Savings

- ✓ Replaced less efficient lamps with low-wattage T8 and T5 throughout. Energy savings = 39,080 kWh. Cost savings = $3,965 annually.
- ✓ Installed **programmable thermostats**. Energy savings = 1500 MMBtu, or 15,000 therms. Cost savings = $14,073 annually.
- ✓ Installed **air curtains**. Energy savings = 1,340 MMBTU. Cost savings = $12,533 annually.
- ✓ Repaired leaks in **compressed air** lines. Energy savings = 51,855 kWh. Cost savings = $4,400.
- ✓ Removing a blower & dust collector with a re-ducting project.

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Actual Energy Savings

$84,000+
annual savings

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- ✓ Streamlined & **standardized skids** to reduce wood waste & cost
- ✓ Moved from 8 skid sizes down to 3 sizes
- ✓ Now able to reuse to ship out smaller furniture pieces, avoiding purchasing costs
- ✓ No skids going to landfill!
- ✓ **Savings = $4,200 annually**

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- ✓ Discovered they were buying cardboard to secure table legs to individual tables
- ✓ Explored repurposing plastic banding instead
- ✓ Ultimately, moved to **bulk shipping**, eliminating need to secure individual legs to individual tables
  - ✓ Reduced cardboard use by 8,250 strips per year, or about 6,560 s.f., or 0.085 tons
  - ✓ **Cost savings of $1,435 annually**

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

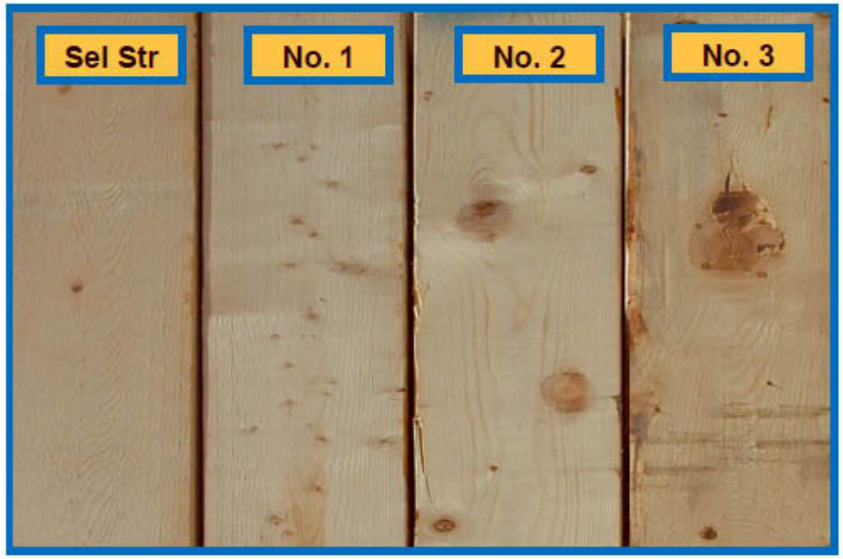
- ✓ Previously no recycling pickup options
- ✓ Explored current market
- ✓ Instituted new recycling program!
- ✓ Diverting 27 yards per week, from landfill, or
  - ✓ 97.6 tons diverted per year
  - ✓ **Cost savings = $6,400 annually**
  - ✓ GHG reduction of 261 MTCO2e

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities



- ✓ Labor spent cutting out bad wood, creating scrap
- ✓ Explored purchasing premium lumber to **reduce cutting waste** and scrap
  - ✓ Eliminating 516 tons of wood purchased
  - ✓ Reduced wood sent to landfill
  - ✓ **Cost savings = $32,000 annually**
  - ✓ GHG reduction of 667 MTCO2e

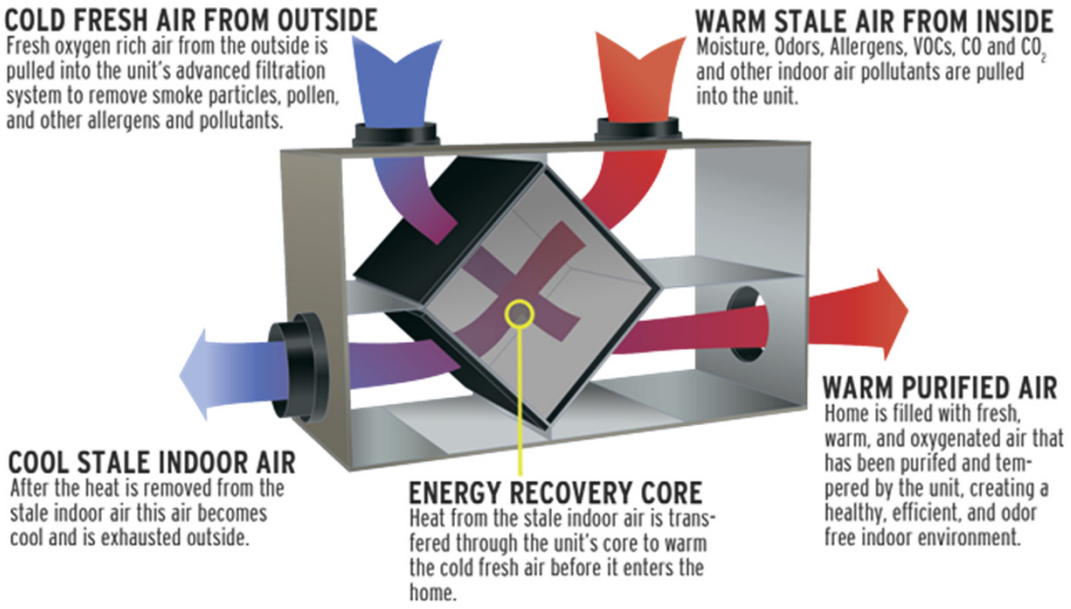
CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- FUTURE- Planning to re-duct to **capture waste heat** from air compressor and vacuum systems.



CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Actual W.A.S.T.E. Stream Opportunities

$44,035+

Current annual savings

CASE STUDY #1

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

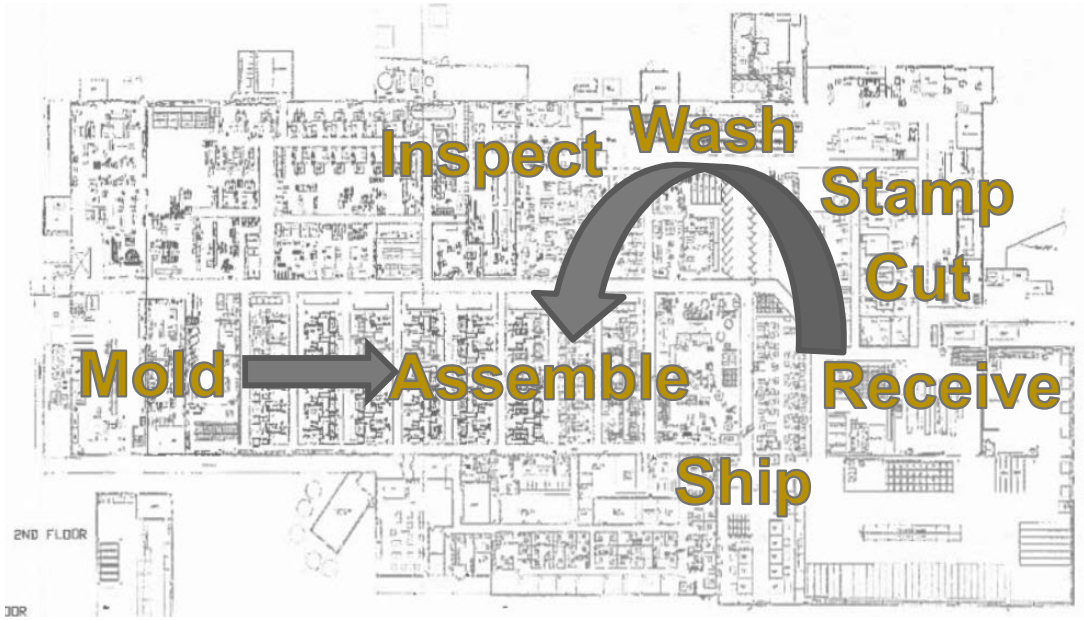
Greenhouse Gas Emissions Opportunities

- Current GHG emissions = 19,457 Metric Tons of CO2-equivelant
- **Reduced 1,691 Tons of CO2-eq**
- Minimize burning of fossil fuels
- Increase energy efficiency via energy improvement projects
- Switch fuel from wood boiler to cleaner natural gas
- Explore potential of solar photovoltaic for zero-emissions electricity generation
- Reduce solid wood waste generation
- Reduce emissions from paints & sealants

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Automotive Seal Manufacturer



PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

CASE STUDY #2

Automotive Seal Manufacturer

Working 3 shifts 5-6 days/wk

Annual production= 24,637,577 pieces

No. Employees = 493

Annual Elec. Cost = $1,816,118

Annual Nat. Gas Cost = $254,073

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- Install FIFO Lanes
- Eliminate banding of metal parts
- Investigate larger coil size & improved coil layout
- Improve communication
- Develop Visuals & Standardize work
- Change to water-based oil to eliminate 2 week rerun

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

$174,487+
annual savings

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean SAVINGS

- Direct **Labor per part** declines by $.13 each.
- **Process bottleneck** would be reduced from .225 minutes per part to .125 minutes per part. This is a 40% reduction on the bottle neck process.
- The **lead time** was reduced from 3.83 days to 3.43 days. A 10% reduction.
- The **Value Added time** increased from 3.77% to 4.21%. This is a 12% improvement. With additional effort, further opportunities could be addressed.
- The **Process Times** was reduced from 40.88 to 24.37. This is a 40% reduction.
- Potential savings from reduced metal scrap TBD.

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

- Lighting
- Compressed Air
- HVAC
- Other – manufacturing tax incentive

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

$145,800+
annual savings

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream SAVINGS

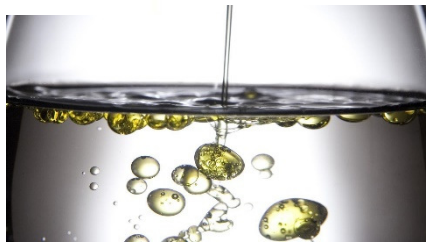
- Issue with parts requiring rework after sitting, due to oil
- Changed from chlorinated paraffin drawing oil to water based oil to eliminate rework of parts that sit 2 weeks.
- Reduced oil usage by 10 barrels per day. **Saving 90,000 gallons per year** due to thinner viscosity.

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream SAVINGS - MOP WATER



- High cost to ship oil-contaminated water from mopping
- In process of modifying process for mop waste water
- Explored switching soap to enable better oil separation

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream SAVINGS- MOP WATER

- **Cost savings = $31,750 annually** (plus $20,827 in energy savings).
- Recycling greywater reduces 87,000 gal. of water annually.
- Additional $15,000 in cost savings potential with greater dilution of wastewater treatment chemicals, to be tested in late 2016.

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream SAVINGS- FUTURE

- FUTURE- planning to implement Reverse Osmosis Reject Water recycling project late 2016.

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

$74,577+

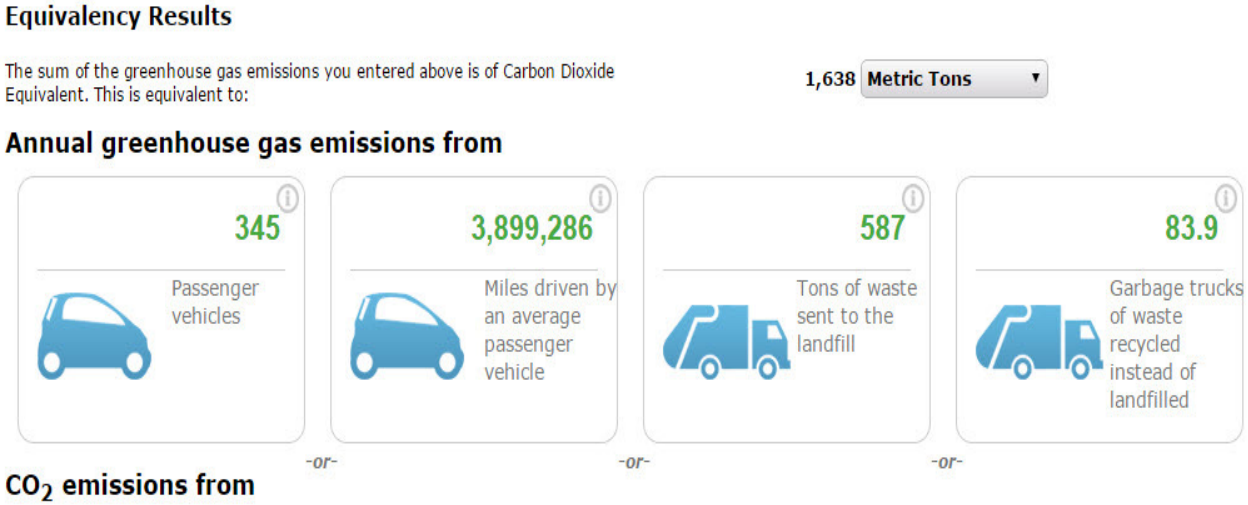
Current annual savings

CASE STUDY #2

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Greenhouse Gas Emissions SAVINGS – 1.600 tons



CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Fabricator of Reusable Steel Racks for Automotive Parts

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Fabricator of Reusable Steel Racks for Automotive Parts

Working 7:00am-4pm 5-6 days/wk

Annual production= 7,000 units ++

No. Employees = 90

Annual Elec. Cost = $37,644

Annual Nat. Gas Cost = $12,053

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- Pull Kanban component supermarket: **$12k savings from inventory reduction + $15k reduction in overproduction**
- Standardize hardware in prototype: **Savings TBD**
- Set up QCO: **$800 savings**
- Move sub-assembly to end of each line: **$18k savings**
- Decrease days of RM inventory / JIT: **$116k savings**
- **Install FIFO conveyor flow from Line to Wash…**

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- Install FIFO conveyor flow from Line to Wash…
- $42k inventory savings
- Labor savings of $60k annually w/ 3 fewer forklifts!
  - Free up labor for production
- Increased production capacity expected to add $1M in sales

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- ✓ Quick Change Over implemented in sawcut area. Cost Savings = $800 annually.
- ✓ Moved subassembly to reduce inventory and transportation distance. One Time Savings = $18,625.
- ✓ Implemented cellular flow using new conveyor system. Cost Savings = $42,412 annually.
- ✓ Increased production capacity by 30%

✓Generated new sales revenue of $1,000,000 based on new capacity.

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- ✓ Implemented most recommendations, including moving sub-assembly closer to assembly, installing new conveyor systems, and other major changes.
- ✓ Raw material inventory reduction from 18 days down to 9 days. One Time Savings = $116,460.
- ✓ New FIFO lanes reduce 60 units of inventory in half. One Time Savings = $29,950.
- ✓ **Actual TOTAL Lean Savings = $1,208,247 in savings**

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

$208,000+ Savings
+ Future **$1M** Sales

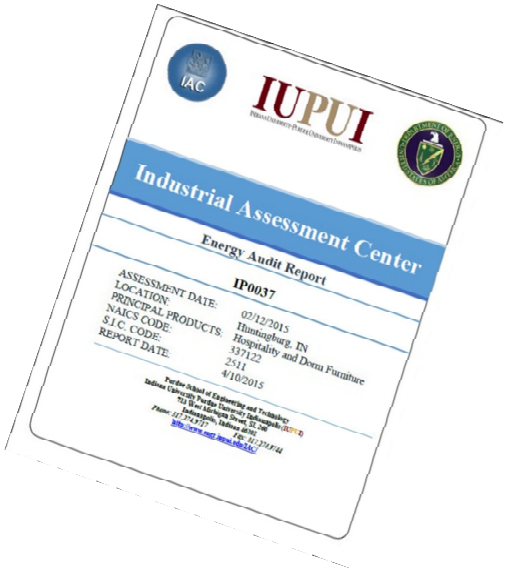
CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

- Lighting
- Compressed Air
- HVAC
- Other – manufacturing tax incentive



CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

$6,200+ Annual Savings

12% Reduction!

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- Paid to send recyclable items to landfill
- Reduced tipping fees by starting to recycle cardboard, plastic, etc.
  - HDPE recycling generating **$3-5k in new revenue!**
- Better policies reduced metal scrap by 20%
  - 7,000 lbs less metal purchased =
  - **Cost savings of $2,800 annually**

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

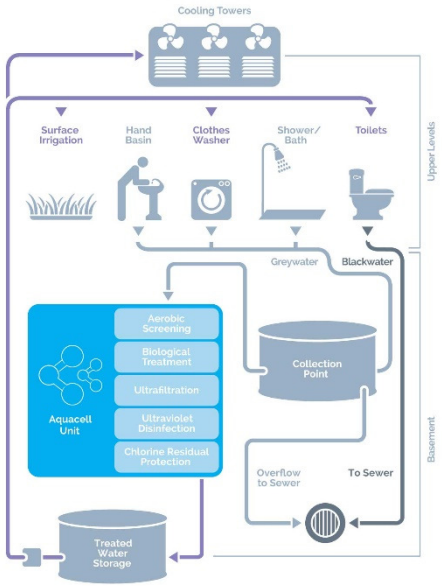
- Significant hazardous waste generated by oil based paint
- Switching to water based paint
  - Reduction in time required to comply with SQG regulations: 62 hours ($930)
  - Eliminated VOC emissions from 14,400 gallons of oil based paint: 9,216 pounds
  - Eliminated purchase and use of: 156 gallons of acetone & 70 gallons of xylene ($4,165)
  - Reduction in **hazardous waste generation: 5,400 pounds** annually ($6,437)
  - **Cost savings: $27,500 annually**

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities



- Reduce water use in wash w/ new greywater recycling system
  - Reduction in potable water use: **13,517 gallons** annually
  - **Cost savings = $4,418 annually**

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

$114,900+

Current annual savings

CASE STUDY #3

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Greenhouse Gas Emissions SAVINGS – 62 tons

CASE STUDY #4

Furnace Manufacturer

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

CASE STUDY #4

Furnace Manufacturer

Working 3 shifts 4-5 days/wk

Annual production= 1.6M units ++

No. Employees = 500

Annual Elec. Cost = $1,578,866

Annual Nat. Gas Cost = $425,113

CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

- Eliminate 16+ minutes of non-value added time – task balancing & work flow analysis
- Eliminate wait time- add buffer for critical raw material coils

CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Key Lean Opportunities

$232,000+
Savings

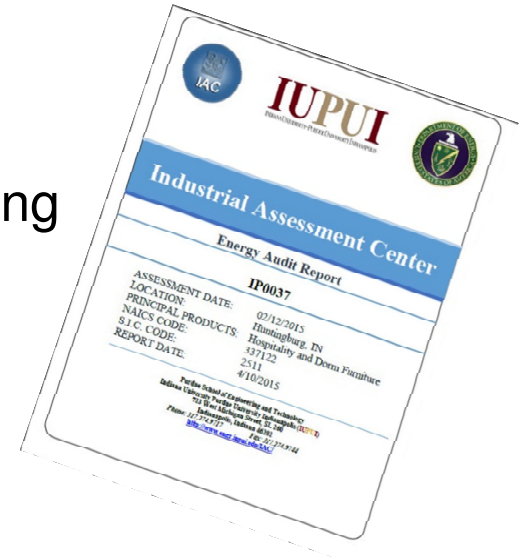
CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

- Lighting
- Compressed Air
- HVAC – waste heat recapture for space heating
- Other – capacitors & on-site peak generation



CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Energy Savings Opportunities

$98,400+
annual savings

CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- Eliminate 90 tons of cardboard overflow/yr in trash- Educate/ monitor
- Redefine job responsibilities (‘light duty’) to include cutting Plastic banding to recycle & sort trash
- Reduce **90 tons a year of wood pallets** in trash - w/ education/monitoring/signage
- Implement returnables & reduce **174,000 pounds of cardboard** at Liquid Line
- Implement returnables & reduce 65,000 pounds cardboard at TXV

CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

W.A.S.T.E. Stream Opportunities

- Eliminate cardboard with returnables: **$112,000** in annual purchase savings + $1,581 in annual disposal fees
- Eliminate wood skids from suppliers with returnables: **$9,750** in annual purchase savings +$1,512 in annual disposal fees
- Properly sort recyclables from trash: $1,510 in annual disposal fee reductions
- Properly sort paper from trash: $442 in annual additional recycling revenue

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

CASE STUDY #4

Assessment Summary:

W.A.S.T.E. Stream Opportunities

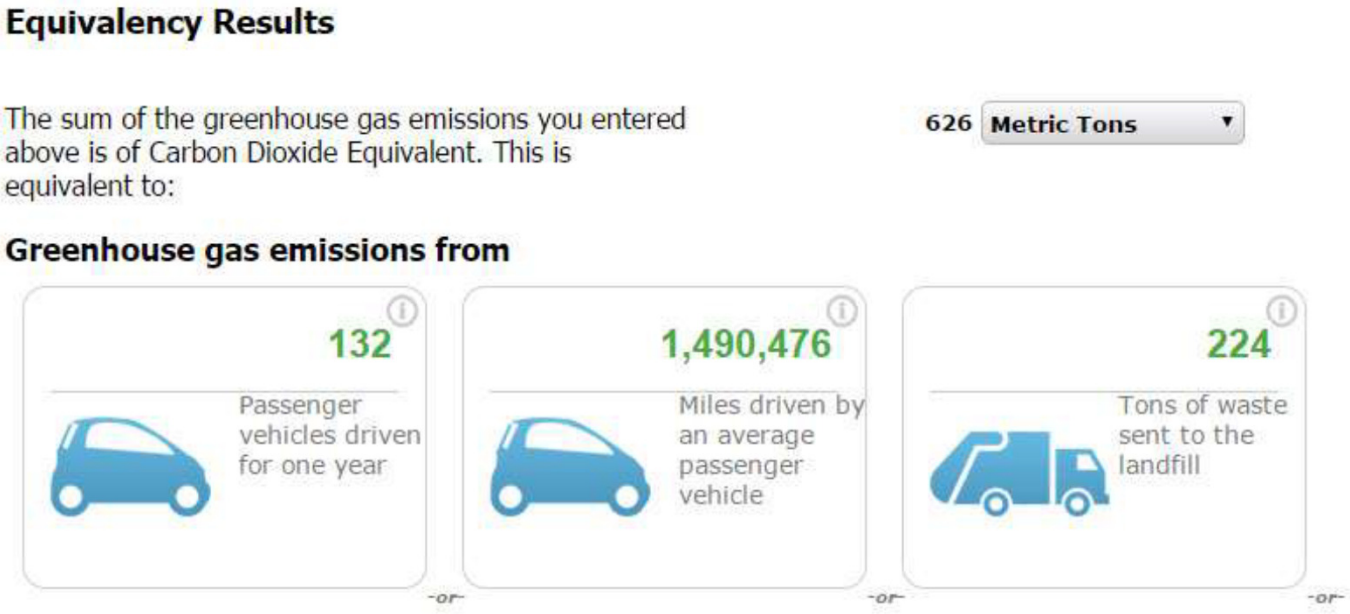
$126,200+
annual savings

CASE STUDY #4

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

Assessment Summary:

Greenhouse Gas Emissions SAVINGS – 626 tons



SUMMARY

ECONOMY
ENERGY
ENVIRONMENT

PURDUE
UNIVERSITY
MANUFACTURING EXTENSION
PARTNERSHIP

Cumulative ACTUAL Assessment Summary:

- Key Lean Opportunities: **$1,629,747** Savings
- Energy Savings Opportunities: **$104,827** Savings
- W.A.S.T.E. Stream Opportunities: **$212,687** Savings
- Greenhouse Gas Emissions Reductions: **2,910** MTCO2e

CONCLUSION

PURDUE UNIVERSITY
MANUFACTURING EXTENSION PARTNERSHIP

For more information, please contact:

Kelly Weger, RA, LEED AP

Lead Project Manager - Sustainability

weger@purdue.edu

734.320.5908